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Effect of Different Organic Manures and PGPR Consortium on Growth and Yield of Bottle Gourd (*Lagenaria siceraria* Mol. Standl.) CV. Anand Bottle Gourd-1

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A B S T R A C T

The present investigation was carried out on "Effect of different organic manures and PGPR consortium on growth and yield of bottle gourd (*Lagenaria siceraria* MOL. STANDL.) cv. ABG-1" at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during summer-2018. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) replicated thrice with six level of organic manures application and two level of PGPR consortium of total 12 combination. The control [75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)] treatment was taken separately means without combination under experimentation. The experimental result revealed that growth and flowering parameters of bottle gourd *viz.*, number of branches/plant (14.38), number of female flowers/plant (3.16), girth of fruit (23.85 cm), length of fruit (30.93 cm) and yield parameters *viz.*, number of fruit/plant (8.78), average fruit weight (637.79 g), yield per plant (5.59 kg) and yield (27.84 t/ha) were found superior with the treatment of M_1 (100% RDN from vermicompost) and it was remained at par with the treatment M_5 (100% RDN from castor cake) and M_3 (100% RDN from FYM). PGPR consortium (1l/ha) showed the best result to growth and flowering parameters *viz.*, minimum days taken for germination (7.60), maximum number of branches/plant (13.95), number of female flowers/plant (3.01), girth of fruit (23.06 cm), length of fruit (29.74 cm) and yield parameters *viz.*, maximum number of fruit/plant (8.40), average fruit weight (609.38 g), yield per plant (5.14 kg) and yield (25.73 t/ha) under experimentation.

Introduction

Bottle gourd (*Lagenaria siceraria* Mol. Standl.) belongs to the family cucurbitaceae with chromosome number of 2n=22. Its native is tropical Africa and Asia. It is commonly known as white-flowered gourd, Lauki, Kaddu and Ghiya. In Gujarat, it is known as Dudhi. In India it is cultivated in about 155 thousand ha area with production of 2573 thousand MT (Anon., 2016-2017). From nutritional point of view, bottle gourd can be considered as nutrition rich fruit vegetable.

It contains considerable amount of water (96.1 g), carbohydrates (2.5 g), protein (0.2 g), fat (0.1 g), minerals (0.5 g), fiber (0.6 g), riboflavin (0.023 mg), vitamin A (10 IU), vitamin C (11 mg), calcium (16 mg), iron (0.4 mg), phosphorus (14 mg) and energy (12 K

cal) per 100 g of edible fruit (Gopalan *et. al.* 1982). Organic manures like vermicompost, FYM and castor cake etc. supply important plant elements both macro and micro. Apart from supplying plant nutrients they favour aggregation of fine soil particles, there by promoting good soil structure and it is also essential for healthy development of soil microorganisms which further carry out biochemical transformation play active role in decomposing organic matter and help in releasing the essential plant nutrients.

PGPR consortium is bio-NPK liquid biofertilizers which contains living organisms when applied to the soil, colonize the rhizosphere or interior of the plant and promote growth by increasing the supply or availability of primary nutrients to the plant. It is an important component of plant nutrient management for sustainable agriculture. Bio-NPK consortium contain five strains of agriculturally beneficial microorganism (two Nitrogen fixer, two Phosphate solubilizers and one potash mobilizer) is the one time solution for all the macronutrient (N, P, K) requirement of crops. Use of Bio-NPK consortium @ 1 litre/ha can save 25 % N, P and K chemical fertilizer with increase in yield with reduction of soil, water and air pollution.

The use of high yielding crop varieties with application of heavy doses of chemical fertilizers without organic manures and bio-fertilizers causes deterioration of soil health in terms of physical and chemical properties of soil, declining of soil microbial activities, reduction in soil humus, increased pollution of soil, water and air. Hence, Nitrogen management through use of organic manures and biofertilizer replacing of present dose of chemical fertilizers of bottle gourd is not worked out so an experiment on "Effect of different organic manures and PGPR consortium on quality of bottle gourd cv. ABG-1" studied.

Materials and Methods

The experiment was conducted at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The effect of different organic manures and PGPR consortium on growth and yield of bottle gourd studied. The experiment was laid out in Randomized Block Design with factorial concept (FRBD) replicated thrice with six level of organic manures application and two level of PGPR without and dose of 1 l/ha of total 12 combination. The control [75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)] treatment was taken separately means without combination under experimentation.

Treatment details given in table no. 1 and treatment combination are given in table no. 2. The bottle gourd cv. Anand Bottle Gourd-1 was sown on 16th February, 2018 at a spacing of 2.0 m × 1.0 m. The gross plot size is 8.0 m x 6.0 m and net plot size is 4.0 m x 4.0 m. The soil of the experimental site was sandy loam, locally known as "*Goradu*" with the pH of soil is 7.06, 0.26 % of organic carbon was determined by walkley and black method, 162.13 kg/ha of available nitrogen was determined by kjeldahl digestion method, 30.92 kg/ha of available phosphorus was estimated by Olson's extraction method, 176.78 kg/ha of available potassium was determined by flame photometric method.

This type of soil is responds well to irrigation and manuring so it is suitable for bottle gourd cultivation. In this experiment three source of organic manurs used *viz*., vermicompost, FYM, castor cake. Vermicompost having 1.8 % N, FYM 0.5 % N and castor cake 3.5 % N. For 100 % of nitrogen dose used quantity of vermicompost 4.16 t/ha, FYM 15 t/ha and castor cake 2.14 t/ha. For 75 % of nitrogen dose used quantity of vermicompost 3.12 t/ha,

FYM 11.25 t/ha and castor cake 1.61 t/ha. PGPR consortium used 1 l/ha. These fertilizers were applied in a single dose at the time of sowing as per treatment plan and application of 50 % recommended dose of N and full dose of P and K given as a basal dose and remaining 50 % of N was applied 30 days after sowing in control. Weeding and plant protection measure were followed as and when needed. The data were statistically analyzed by the method suggested by Panse and Sukhatme (1967).

Results and Discussion

Growth and flowering parameters

The results obtained from experiment are presented in relevant Tables 3.

Effect of organic manures

The experimental result revealed that growth and flowering parameters of bottle gourd *viz*., number of branches/plant (14.38), number of female flowers/plant (3.16), girth of fruit (23.85 cm) and length of fruit (30.93 cm) were found superior with the treatment of M_1 (100% RDN from vermicompost) and it was remained at par with the treatment M_5 (100% RDN from castor cake) and M_3 (100% RDN from FYM).

While, days taken for germination, number of male flowers/plant and sex ratio were found non-significant. Application of vermicompost might be due to better not only provided plant nutrient but also improve the physical condition of soil in respect of granulation, friability porosity which in term provided a balance nutritional environment favorable both soil rhizosphere and in plant system Reddy *et al.,* (1998). The results were also in accordance with the findings of Das *et al.*, (2015) and Nagar *et al.,* (2017) in bottle gourd.

Effect of PGPR consortium

Growth and flowering parameters *viz*., minimum days taken for germination (7.60), maximum number of branches/plant (13.95), number of female flowers/plant (3.01), girth of fruit (23.06 cm) and length of fruit (29.74 cm) were found superior with the application of P_2 (With PGPR consortium 1 l/ha). While, number of male flowers/plant and sex ratio were found non-significant. The early germination could be due to the ability of *Azospirillum* to produce some growth promoting substances like auxins which might have led to enhance the physiological process in seeds, increased uptake of the nutrient and moisture (Kloepper, 2003). The colonization of this bacterium reduced the incidence of seed mycoflora which indirectly enhanced seed germination. PGPR consortium is effective in nitrogen fixation and processing genetic information for cube ring pathogens of crops plants, synthesis of plant growth promoting hormones and proteins, enzymes and other factor that improve uptake of essential nutrients by plants utilized in farming this was also confirmed by Pandey and Kumar (1989). The results were also in accordance with the findings of Kumar *et al.,* (2012) in bitter gourd, Asha *et al.,* (2018) in ridge gourd, Das *et al.*, (2015) and Patel *et al.,* (2018) in bottle gourd.

Yield and its attributing parameters

The results obtained from experiment are presented in relevant Tables 4.

Effect of organic manures

Yield and yield attributing parameters *viz*., number of fruit/plant (8.78), average fruit weight (637.79 g), yield per plant (5.59 kg) and yield (27.84 t/ha) were found superior with the treatment of M1 (100% RDN from vermicompost) and it was remained at par

with the treatment M5 (100% RDN from castor cake) and M3 (100% RDN from FYM). The beneficially effect of vermicompost on yield and yield attributing parameters might be due to enhanced supply of micro and macro- nutrients during entire growing season. Vermicompost along with nutrients from soil particularly at later stage of crop growth might have increases the rate of photosynthesis with further increased vegetative growth and provided more site for translocation of photosynthesizes with ultimately increased the yield. The results were also in accordance with the findings of Nagar *et al.*, (2017), Singh *et al.*, (2012) and Das *et al.*, (2015) in bottle gourd.

Table.1 Details of various treatments

Sr. No.	Treatments	Symbol
Factor A : Organic manures (M)		
1.	100% RDN from vermicompost (4.16 t/ha)	M_1
2.	75% RDN from vermicompost (3.12 t/ha)	M_2
3.	100% RDN from FYM (15 t/ha)	M_3
4.	75% RDN from FYM (11.25 t/ha)	M_4
5.	100% RDN from castor cake (2.14 t/ha)	M_5
6.	75% RDN from castor cake (1.61 t/ha)	M_6
Factor B : PGPR consortium (P)		
1.	Without PGPR consortium	P_1
2.	With PGPR consortium (1 lit/ha)	P_2

Control : 75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)

Table.2 Treatment combinations

Sr No.	Treatment combination	Notation
1.	100% RDN from vermicompost	M_1P_1
2.	100% RDN from vermicompost + PGPR consortium (1 l/ha)	M_1P_2
3.	75% RDN from vermicompost	M_2P_1
4.	75% RDN from vermicompost + PGPR consortium (1 l/ha)	M_2P_2
5.	100% RDN from FYM	M_3P_1
6.	100% RDN from FYM + PGPR consortium (1 l/ha)	M_3P_2
7.	75% RDN from FYM	M_4P_1
8.	75% RDN from FYM + PGPR consortium (1 l/ha)	M_4P_2
9.	100% RDN from castor cake	M_5P_1
10.	100% RDN from castor cake + PGPR consortium (1 l/ha)	M_5P_2
11.	75% RDN from castor cake	M_6P_1
12.	75% RDN from castor cake + PGPR consortium (1 l/ha)	M_6P_2
13.	Control 75:50:50 NPK kg/ha + FYM 15 t/ha (RDF)	M_0P_0

Note : Common dose of FYM 15 t/ha applied in treatment no. 1 to 12.

Effect of PGPR consortium

PGPR consortium (1l/ha) showed the best result to maximum number of fruit/plant (8.40), average fruit weight (609.38 g), yield per plant (5.14 kg) and yield (25.73 t/ha) under experimentation. This might be due to with application of PGPR consortium, secretion of ammonia also enhanced in the rhizosphere, which enhance the nutrient uptake potential of plant and improve the fruit yield and yield attributing parameters. PGPR consortium also produces plant growth regulatory substances which stimulate plant growth and yield. Similar finding were also reported Das *et al.,* (2015) and Patel *et al.,* (2018) in bottle gourd, Prasad *et al.,* (2009) and Kumar *et al.,* (2012) in bitter gourd and Anjanappa *et al.,* (2012) in cucumber.

Tables.3 Effect of different organic manures and PGPR consortium on growth parameters of bottle gourd

Treatment	Days taken for germination	Number of branches/ plant (At the time of first picking)	Number of male flowers/plant (At the time of first picking)	Number of female flowers/plant (At the time of first picking)	Sex ratio (Female : Male)	Girth of fruit (cm) (At the time of 5th picking)	Length of fruit (cm) (At the time of 5th picking)
Factor A : Organic manures (M)							
M_1	7.65	14.38	18.86	3.16	0.168	23.85	30.93
M_2	8.46	12.30	17.34	2.72	0.155	21.16	28.32
M_3	8.10	13.72	17.86	2.95	0.163	22.57	29.75
M_4	8.77	11.71	16.89	2.54	0.149	21.03	26.42
M_5	7.85	13.97	18.16	3.02	0.164	22.87	30.01
M_6	8.51	12.01	17.05	2.66	0.154	21.11	27.54
S.Em.±	0.31	0.50	0.51	0.12	0.007	0.63	0.86
CD at 5%	NS	1.45	NS	0.34	NS	1.83	2.51
Factor B : PGPR consortium (P)							
P_1	8.85	12.09	17.49	2.68	0.153	21.14	27.93
P_2	7.60	13.95	17.90	3.01	0.165	23.06	29.74
S.Em.±	0.18	0.29	0.30	0.07	0.004	0.36	0.50
CD at 5%	0.52	0.84	NS	0.20	NS	1.05	1.45
Interaction (MxP)	NS	NS	NS	NS	NS	NS	NS
Control vs Rest treatment							
Control	9.65	11.12	15.55	2.02	0.131	18.31	24.88
Rest treatment	8.22	13.02	17.69	2.84	0.159	22.10	28.83
S.Em.±	0.32	0.52	0.53	0.12	0.007	0.65	0.90
CD at 5%	0.94	1.51	1.56	0.35	0.021	1.90	2.61
CV%	9.05	9.44	7.19	10.25	11.064	7.03	7.38

Tables.4 Effect of different organic manures and PGPR consortium on yield and it's attributing parameters of bottle gourd

Treatment	Number of fruits per plant	Average weight of fruit (g)	Yield per plant (kg)	Yield (t/ha)
Factor A : Organic manures (M)				
M_1	8.78	637.79	5.59	27.84
M_2	7.94	566.52	4.50	22.71
M_3	8.40	607.19	5.10	25.29
M_4	7.27	546.50	3.98	20.34
M_5	8.54	618.38	5.28	26.36
M_6	7.69	556.80	4.28	21.56
S.Em.±	0.27	19.25	0.18	0.92
CD at 5%	0.80	56.18	0.53	2.68
Factor B : PGPR consortium (P)				
P_1	7.81	568.36	4.44	22.30
P_2	8.40	609.38	5.14	25.73
S.Em.±	0.16	11.11	0.11	0.53
CD at 5%	0.46	32.44	0.31	1.55
Interaction (MxP)	NS	NS	NS	NS
Control vs Rest treatment				
Control	6.96	510.75	3.56	19.09
Rest treatment	8.10	588.86	4.79	24.02
S.Em.±	0.29	20.04	0.19	0.96
CD at 5%	0.83	58.48	0.56	2.79
CV%	8.40	8.09	9.55	9.51

The results obtained from research experiment, it can be concluded that the application of 100% RDN from vermicompost (4.16 t/ha) exhibited the maximum number of branches/plant and number of female flowers/plant at the time of first picking and girth of fruit and length of fruit at the time of 5th picking and also the maximized number of fruits/plant, average weight of fruit, yield per plant and yield per hectare of bottle gourd cv. Anand Bottle Gourd-1.

Application of PGPR consortium (1 l/ha) recorded the minimum days taken for germination and maximum number of branches/plant and number of female flowers/plant at the time of first picking and girth of fruit and length of fruit at the time of 5th picking and also maximized number of fruits/plant, average weight of fruit, yield per plant and yield per hectare of bottle gourd cv. Anand Bottle Gourd-1.

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